

Scottish International Conference on Multidisciplinary Research and Innovation – SICMRI 2026

ALGORITHM OF PREVENTIVE AND THERAPEUTIC MEASURES FOR WORKERS IN METALWORKING ENTERPRISES

Khatamova Madinakhon Anvarovna

3rd year student of basic doctoral studies

Samarkand State Medical University, Samarkand, Uzbekistan.

Abduhakimov Dilmurod Bahodir o'g'li

Fifth-year student majoring in periodontology, Department of Dentistry,

Samarkand State Medical University Samarkand, Uzbekistan.

ANNOTATION

Occupational exposure in the metalworking industry encompasses a multifactorial array of hazards, including metal dust, chemical aerosols, elevated temperatures, mechanical vibration, and psychosocial stress. These conditions adversely affect both oral and systemic health, contributing to a higher prevalence of periodontal diseases, dental caries, gastrointestinal disorders, and hepatobiliary dysfunction among industrial employees. The development of a structured, evidence-based algorithm for preventive and therapeutic interventions is critical for mitigating morbidity and enhancing worker health.

This study aimed to design, implement, and evaluate a comprehensive intervention algorithm for employees of metalworking enterprises. A clinical-interventional investigation was conducted among 200 workers aged 20–55 years. Participants were divided into an experimental group ($n = 130$), directly exposed to occupational hazards, and a control group ($n = 70$) with minimal exposure. Assessments included oral hygiene indices, periodontal status, liver and gastrointestinal function, and evaluation of occupational exposure.

The proposed algorithm integrates workplace modifications, regular medical and dental monitoring, professional oral hygiene procedures, nutritional optimization, lifestyle counseling, pharmacotherapy, and targeted health education. After six months of application, the experimental group demonstrated statistically significant improvements in plaque and gingival bleeding indices, biochemical liver markers, and reduction of gastrointestinal symptoms compared with baseline and control group measurements ($p < 0.05$).

The algorithm emphasizes a multidisciplinary approach tailored to the specific conditions of metalworking enterprises. Its adoption offers a practical model for improving occupational health, reducing the incidence of chronic diseases, and enhancing quality of life among industrial workers.

Keywords: occupational health, preventive strategies, therapeutic algorithm, periodontal disease, hepatobiliary dysfunction, gastrointestinal disorders, metalworking industry.

ANNOTATSIYA

Metallga ishlav berish sanoatidagi kasbiy ta'sir metall changi, kimyoviy aerozollar, yuqori harorat, mexanik tebranish va ruhiy-ijtimoiy stress kabi ko'p omilli xavflarni o'z ichiga oladi. Bu holatlar og'iz bo'shlig'i va umumiy a'zolar salomatligiga salbiy ta'sir ko'rsatib, sanoat xodimlari orasida parodont kasalliklari, tish kariyesi, oshqozon-ichak kasalliklari va gepatobiliar disfunktsiyaning ko'proq uchrashiga sabab bo'ladi. Kasallanishni kamaytirish va ishchilar

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salomatligini yaxshilash uchun profilaktik va terapevtik aralashuvlarning tizimli, dalillarga asoslangan algoritmini ishlab chiqish muhim ahamiyatga ega.

Ushbu tadqiqot metallga ishlov berish korxonalari xodimlari uchun kompleks aralashuv algoritmini loyihalash, amalga oshirish va baholashga qaratilgan. 20-55 yoshdagi 200 nafar ishchi orasida klinik-intervensiyon tekshiruv o'tkazildi. Ishtirokchilar kasbiy xavf-xatarlarga bevosita ta'sir ko'rsatadigan tajriba guruhiga ($n = 130$) va minimal ta'sir ko'rsatadigan nazorat guruhiga ($n = 70$) bo'lingan. Og'iz bo'shlig'i gigiyenasi ko'rsatkichlari, parodont holati, jigar va oshqozon-ichak trakti faoliyati, kasbiy ta'sirni baholash kabilar baholandi.

Taklif etilgan algoritm ish joyini o'zgartirish, muntazam tibbiy va stomatologik monitoring, og'iz bo'shlig'i gigiyenasining professional protseduralari, ovqatlanishni optimallashtirish, turmush tarzi bo'yicha maslahatlar, farmakoterapiya va maqsadli sog'liqni saqlash ta'limini birlashtiradi. Olti oylik qo'llashdan so'ng tajriba guruhida dastlabki va nazorat guruhlari ko'rsatkichlariga nisbatan blyashka va milklardan qon ketish ko'rsatkichlari, jigarining biokimyoviy markerlari va oshqozon-ichak trakti belgilarining statistik jihatdan sezilarli yaxshilanishi kuzatildi ($r < 0,05$).

Algoritmda metallga ishlov berish korxonalarining o'ziga xos sharoitlariga moslashtirilgan ko'p tarmoqli yondashuvga urg'u berilgan. Uning qabul qilinishi mehnatni muhofaza qilish, surunkali kasalliklar bilan kasallanishni kamaytirish va sanoat ishchilarining hayot sifatini yaxshilashning amaliy modelini taqdim etadi.

Kalit so'zlar: mehnat gigiyenasi, profilaktika strategiyasi, davolash algoritmi, parodont kasalligi, gepatobiliar disfunktsiya, oshqozon-ichak kasalliklari, metallga ishlov berish sanoati.

АННОТАЦИЯ

Профессиональное воздействие в металлообрабатывающей промышленности включает в себя многофакторный спектр опасностей, включая металлическую пыль, химические аэрозоли, повышенную температуру, механическую вибрацию и психосоциальные стрессы. Эти состояния негативно влияют как на здоровье полости рта, так и на организм, что способствует более высокой распространенности заболеваний пародонта, кариеса зубов, заболеваний желудочно-кишечного тракта и дисфункции гепатобилиарной системы среди промышленных работников. Разработка структурированного, основанного на доказательствах алгоритма профилактических и лечебных вмешательств крайне важна для снижения заболеваемости и улучшения здоровья работников.

Данное исследование было направлено на разработку, внедрение и оценку комплексного алгоритма вмешательства для работников металлообрабатывающих предприятий. Клинико-интервенционное исследование было проведено среди 200 работников в возрасте 20-55 лет. Участники были разделены на экспериментальную группу ($n = 130$), непосредственно подвергающуюся воздействию профессиональных вредностей, и контрольную группу ($n = 70$) с минимальным воздействием. Оценка включала показатели гигиены полости рта, состояние пародонта, функцию печени и желудочно-кишечного тракта, а также оценку профессионального воздействия.

Предлагаемый алгоритм включает в себя модификацию рабочего места, регулярный медицинский и стоматологический мониторинг, профессиональные процедуры гигиены полости рта, оптимизацию питания, консультации по образу жизни, фармакотерапию и целенаправленное медицинское образование. После шестимесячного применения в экспериментальной группе наблюдалось статистически значимое улучшение показателей

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кровоточивости бляшек и десен, биохимических маркеров печени и снижение симптомов желудочно-кишечного тракта по сравнению с показателями исходной и контрольной групп ($p < 0,05$).

Алгоритм подчеркивает междисциплинарный подход, адаптированный к конкретным условиям металлообрабатывающих предприятий. Его принятие предлагает практическую модель для улучшения охраны труда, снижения заболеваемости хроническими заболеваниями и повышения качества жизни работников промышленности.

Introduction

Metalworking industries are characterized by high-risk working environments where employees are routinely exposed to heavy metals (iron, chromium, nickel), chemical solvents, lubricating oils, dust, and high temperatures. These exposures, compounded by mechanical vibration, shift work, and psychosocial stress, negatively impact multiple physiological systems, including oral, gastrointestinal, and hepatobiliary function.

Periodontal disease, dental caries, functional dyspepsia, gastritis, and hepatobiliary disorders are highly prevalent among these workers. These conditions reduce occupational performance, compromise quality of life, and increase healthcare costs. Current occupational health programs often lack structured, standardized preventive and therapeutic measures, which limits their effectiveness.

An evidence-based algorithm that incorporates early detection, timely intervention, and continuous monitoring is essential to mitigate occupationally induced morbidity. A systematic approach ensures comprehensive management of both workplace-related and individual health risk factors.

Materials and Methods

Study Population

The study included 200 employees aged 20–55 years from two large metalworking enterprises. Participants were stratified into:

- Experimental group ($n = 130$): employees with direct occupational exposure (welders, machinists, foundry workers).
- Control group ($n = 70$): administrative personnel with minimal exposure.

Inclusion criteria: minimum of three years of employment, absence of pre-existing chronic systemic diseases unrelated to occupational factors.

Assessment Protocol

Oral Health: Plaque index (PI), gingival bleeding index (GBI), periodontal pocket depth (PPD), clinical attachment level (CAL).

Gastrointestinal Assessment: Symptom questionnaire (dyspepsia, epigastric discomfort, bloating), clinical examination, and laboratory tests.

Hepatobiliary Assessment: ALT, AST, bilirubin, alkaline phosphatase, liver ultrasonography.

Occupational Exposure: Duration, type, and intensity of chemical and metal exposure.

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Development of the Algorithm

The algorithm was developed based on risk factor analysis, evidence-based preventive measures, and feasibility in the workplace. Its components include:

1. Workplace Modifications: Improved ventilation, mandatory PPE, reduction of dust and chemical exposure.
2. Medical and Dental Surveillance: Routine examinations every 3–6 months with biochemical and imaging evaluations.
3. Professional Oral Hygiene: Scaling, polishing, and personalized hygiene instruction.
4. Nutritional Optimization: Hepatoprotective diets, balanced meals, and adequate hydration.
5. Lifestyle Measures: Stress management, smoking cessation, alcohol limitation.
6. Pharmacological Interventions: Anti-inflammatory and antimicrobial therapy for periodontal conditions, hepatoprotective agents when indicated.
7. Health Education: Workshops and printed materials emphasizing hygiene, occupational risks, and preventive strategies.

Results

- Experimental group had significantly higher PI and GBI compared to controls ($p < 0.05$).
- 42% of exposed employees presented with mild to moderate periodontitis.
- Elevated liver enzymes were observed in 28% of the experimental group.
- Gastrointestinal complaints were reported by 23% of exposed workers.

Outcomes After 6 Months

- Plaque index decreased by 33%, and gingival bleeding by 38% in the experimental group.
- Periodontal pocket depth reduced in 71% of workers with mild/moderate periodontitis.
- ALT and AST levels normalized in 67% of employees with baseline elevations.
- Frequency and severity of gastrointestinal symptoms were significantly reduced.

The control group exhibited minimal change in all evaluated parameters.

Discussion

Workers in metalworking industries face elevated risk for periodontal and hepatobiliary disorders due to cumulative exposure to heavy metals, chemical aerosols, and psychosocial stress. Chronic exposure promotes oxidative stress, metabolic disturbances, inflammatory changes, and functional impairment in both oral and hepatic tissues.

Implementation of the structured algorithm demonstrated measurable improvements across oral, gastrointestinal, and hepatic parameters. This underscores the importance of multidisciplinary intervention encompassing occupational medicine, dentistry, nutrition, and

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health education. Early monitoring and targeted preventive measures are essential for minimizing chronic disease progression and maintaining workforce health.

Conclusion

1. Metalworking employees are at higher risk for periodontal and hepatobiliary disorders compared to non-exposed personnel.
2. Occupational exposure to metals and chemicals is a major contributing factor.
3. A structured algorithm integrating preventive, therapeutic, and educational interventions improves clinical outcomes and biochemical parameters.
4. Adoption of routine occupational monitoring, dental care, and lifestyle interventions is recommended for metalworking enterprises.

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